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JELLIES AND MARMALADES FROM CITRUS FRUITS

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Investigations of the by-products of the citrus industry by the Division of Viticulture during the past two years have yielded some results regarding the possibilities of jelly making that appear to be of value.

They have shown, what has been doubted by some, that very attractive and palatable jellies and marmalades can be made from Californian oranges, lemons, and pomelos. They have shown further that these fruits contain large amounts of pectin which can be used in combination with such fruits as strawberries, cherries, and peaches, containing little or no pectin, to produce jellies with the characters and flavors of these latter fruits. No outside jelling material such as gelatin is needed in either case. The interest in this subject is evidenced by the number of letters received asking for information regarding citrus jellies and marmalades and indicates that these products may furnish an outlet for some of our citrus crop.

The chief aim of this publication is to furnish information for home use, but the principles discussed apply equally to production on an industrial scale.

Pectin.—Pectin is the essential constituent of jellies and marmalades because its presence is necessary to give the desired consistency. Citrus fruits are very rich in this substance. It is most abundant in the white inner portion of the skin, but occurs also in the pulp of the fruit.

Extraction of Pectin.—The pectin is held firmly by the tissues of the fruit and is not very soluble in cold water. By heating the fruit in the juice or in water, the tissues are softened and the pectin dissolved by the liquid. The pectin solution thus obtained serves as the basis for jelly or marmalade.

The whole fruit is used and is first cut into pieces about one-fourth of an inch thick. If cut too fine, the fruit in cooking becomes "mushy" and the pectin solution very cloudy; if too coarse, the pectin is imperfectly extracted. The liquid should cover the fruit and boil slowly, the volume of water being kept constant by additions of water when necessary. Rapid and too prolonged boiling softens and breaks up the fruit and gives a muddy liquor. About one hour's slow boiling has given very satisfactory results. At the end of this time the liquid contains the pectin and should be clear and of a more or less gummy consistency. It must be separated from the fruit while still hot to avoid the necessity of too much pressing. Most of the pectin solution may be strained off through a coarse mesh bag (e.g., cheesecloth) without pressure; the remaining liquid may be extracted by gentle pressure. The press liquor may be kept separate.

Clearing the Pectin Solution.—Jelly is most attractive if bright. The clearing must be done before sugar is added. The most simple and effective method found so far is to allow the pectin solution to stand twenty-four hours to settle. The clear liquid can then be decanted or siphoned off and used without further clarification. The sediment can be strained through a heavy felt or flannel jelly bag. Fruit jars or bottles are suitable containers for the liquid during the settling process. Tall earthenware crocks may be used for larger quantities.

If the boiling of the fruit and draining off of the pectin solution have been carefully done, the liquid obtained will often be clear and no settling necessary. If large jelly bags are available, the hot pectin solution may be filtered through them to give a clear liquid and the settling process dispensed with.

Acidity of Pectin Solution.—Besides pectin, acid is also necessary for jelling. Ripe oranges and grape fruit do not contain quite enough of this material to give a good jelly in all cases. This deficiency is most conveniently made up by the addition of lemons. Four to six lemons should be cut up with each dozen oranges or pomelos and boiled with them during the pectin extraction. Tests have shown that the pectin solution should contain at least .8 to 1 per cent of citric acid to give the best results. The above proportion of lemons will give this amount of acid.

Sugar.—In addition to pectin and acid, sugar is necessary. Cane sugar and beet sugar are equally good for this purpose. They are the same chemically and the prejudice against beet sugar seems unwarranted. Sugar causes the pectin to jell and preserves the product. The amount of sugar necessary to cause jelling will vary inversely with

the amount of pectin present; that is, the richer the pectin content of the solution, the less sugar is required to give a jelly. A jelly may be obtained with 50 per cent of sugar or less where there is a large amount of pectin present. Such a jelly, however, will ferment or spoil through the action of yeasts or molds unless sterilized. At least 65 per cent of sugar must be present to prevent spoiling and unless jelly contains this amount it must be hermetically sealed and sterilized to preserve it.

Ordinarily one part or one and one-fourth parts of sugar by volume is added to each part of pectin solution. This gives a liquid



Fig. 1.—Jelly “sheeting” from a spoon at jelling point.

which is considerably less than 65 per cent sugar. The mixture is heated to boiling until the excess water is boiled off and in this way the sugar increased in the remaining liquid to any desired degree. The boiling down also increases the pectin content in the same way, thus making it more certain that the liquid will jell.

To tell when the sugar has reached the proper concentration, due to boiling down, most jelly makers use the simple test of dipping a spoon into the boiling liquid and allowing it to drip. If it hardens or congeals in strips from the lower edge of the spoon, it is ready to pour into glasses. The main fallacy of this test is that it does not always indicate 65 per cent sugar and should jelling take place very much below this degree, owing to a large amount of pectin, the product might spoil. The thermometer test is more reliable. For this test,

first heat water to boiling, insert a Fahrenheit thermometer and read the boiling point. For sea level points or moderate elevations this will be about 211 or 212° F. Then insert the thermometer in the boiling jelly solution. When it boils at 8° F. above the boiling point of water, it has reached the proper sugar concentration. When water boils at

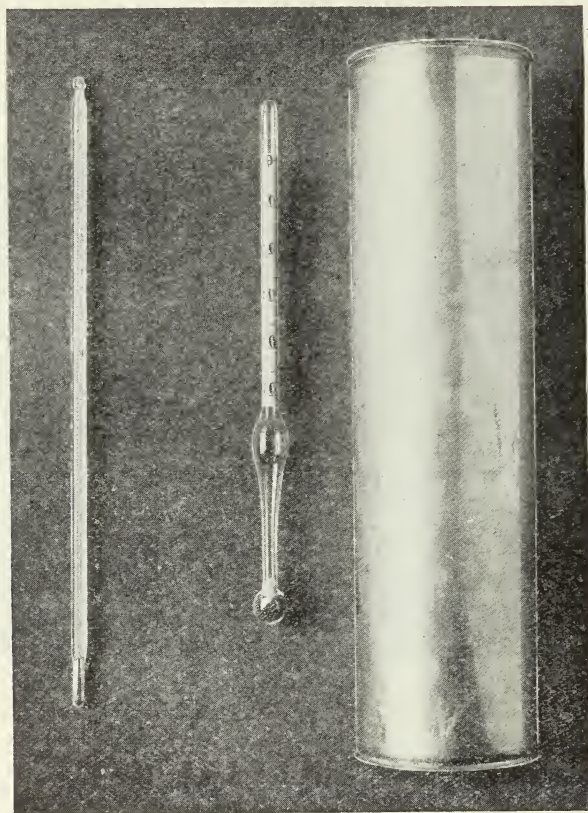


Fig. 2.—Sugar Tester, Chemical Thermometer and Cylinder for determining point at which the jelly is sufficiently concentrated.

212° F., the jelly should boil at 220° F. Practically all large producers of jelly use the two methods in conjunction. A suitable thermometer for this purpose is one of the form known as “chemical thermometers” registering up to 240° F. One sufficiently accurate will cost 75 cents to \$1.00.

A third method is to test the hot liquid with a sugar spindle, hydrometer, “scale,” or “tester,” as it is variously termed. The hot solution is poured into a tall tin or glass cylinder about fourteen inches

by one and one-half inches and the sugar hydrometer inserted. The degree is read off on the scale at the surface of the liquid. Two different scales are in use on sugar hydrometers, namely, the Brix and Baumé scales. When the boiling liquid has reached the proper concentration for jelly, the Brix scale will read 59° and the Baumé will read 32°. This means that when the jelly cools down to room temperature it will show 65° Brix, corresponding to 65 per cent sugar. The Brix hydrometer is made to give per cent of sugar in solutions when tested at 63.5° F. When used in hot solutions near the boiling point, the instrument gives a reading six to eight per cent too low owing to the fact that liquids expand on heating. This explains why 59° Brix in the hot juice corresponds to 65 per cent of sugar in the cooled jelly. The Balling hydrometer is practically the same as the Brix and can be used just as well. If a hydrometer of any kind is employed, the exact meaning of the scale must be understood.

For practical purposes, the thermometer test will be found most reliable and convenient.

Flavor.—The boiling of the fruit to extract the pectin and the boiling of the pectin and sugar solution drive off much of the fruit flavor, and aroma. In order to replace this lost flavor, the jelly may be flavored with orange or lemon extract or oil. It should be allowed to cool to about 175° F., after it has reached the jelling point, before any flavoring is added. Some of the flavoring evaporates if the jelly is too hot when it is added. Extracts or oils of lemon or orange may be obtained from grocery stores or the jelly may be flavored by one of the following methods. (1) Grate the yellow rind from two oranges or two lemons fine on a vegetable grater. To the gratings add about three teaspoonsfull of water and squeeze the liquid from the mixture through a small cloth bag. This liquid will flavor about eight glasses of jelly when added after the jelly has cooled to about 175° F., in the pot. (2) A more concentrated extract may be made by adding one ounce of pure grain alcohol to the gratings from two oranges or lemons and allowing this to stand in a covered glass over night. The extract can then be pressed from the gratings. Six to ten drops of this, per glass, will be sufficient. If the clearness of the jelly is not important, it may be flavored by adding a small amount of grated dried peel.

Bitterness.—Oranges picked at the beginning of the season give bitter jelly and marmalade. The fresh fruit is not bitter, but when it is boiled the bitterness becomes apparent. But if the fruit is used well after the start of the season, no bitterness will develop. This is a very important point and must be borne in mind when

making orange jelly or marmalade. If a little bitterness is desired, it can be obtained by using a little "grape fruit" with the ripe oranges.

Blending with Other Fruits.—The pectin solution from oranges and lemons is more or less neutral in flavor but is rich in pectin and can therefore be used to fortify juices of strawberries, peaches, cherries, raspberries, etc., which are too weak in pectin to jell themselves. In this way we can make jellies with the flavors of these various fruits. Blends can also be made with fruits containing enough pectin of their own to give jellies. Loganberries or currants have been found to give excellent jelly when blended with oranges. This may be used as a means of increasing the quantity of jelly made, or of diluting the acidity or flavor of the fruit.

Jelly from Dried Citrus Fruits.—Dried oranges and lemons, when soaked in water and boiled, give a pectin solution. Four to six lemons to a dozen oranges is a suitable proportion. From this solution jelly or marmalade can be made. This offers great possibilities for the use of dried orange and lemon culls in bakeries in place of the dried apple waste now used. The pectin solution from the dried fruit can be used as a basis for large numbers of blended jellies. If sliced thin, the fruit dries very readily in the sun or it may be artificially dried in some form of fruit evaporator.

The skins of oranges or lemons of which the juice or pulp has been used for other purposes will serve as an economical source of pectin for domestic use. They may be used directly or dried and kept until needed. The drying must be carefully done. If cut into small pieces they will dry in an ordinary dry room. If dried too slowly they may mold, if dried in an oven they may be scorched.

RECIPES FOR JELLY

By following the definite directions given in the following recipes, satisfactory jellies should result. These recipes are the results of experiments and have been thoroughly tested.

Orange-Lemon Jelly Number One.—Select six thoroughly ripe oranges and three lemons. Cut the whole fruit (including whole skins) into slices about one-fourth of an inch thick. Cover with water and boil slowly adding water occasionally to replace that boiled off. At the end of an hour the fruit should be soft, but not "mushy" and the liquid clear. Strain the hot juice through a coarse bag without pressure and place it in jars or bottles to settle. Press out the remaining liquid from pulp and set aside to settle. After twenty-four hours, pour or siphon off the clear liquid. The sediment may be filtered

through a jelly bag or thrown away. To each pint of liquid add one and one-fourth pints of sugar. Boil with frequent skimming until it reaches 8° F. above the boiling point of water, or until the liquid will "sheet" from a spoon. Allow to cool to about 175° F. Add a little orange extract to flavor. Pour into glasses. Cover with a thin layer of melted paraffin.

*Orange-Lemon Jelly Number Two.**—Use six oranges and three lemons. This will give eight glasses of jelly. Remove and discard the thin outer layer of the rinds, leaving the white portion on the fruit. Remove the white. Tie this in a close mesh bag. Shred the pulp very fine. Add three times its bulk of water. Boil hard forty-five minutes with the bag of white rind immersed in the liquid. This furnishes the pectin. Skim frequently. Remove the bag and throw the contents away. Strain off the clear liquid and let stand twenty-four hours. Carefully siphon or pour off the clear liquid and boil ten minutes. Add an equal quantity of sugar and boil till it jells (about five minutes). When the liquid "sheets" from a spoon it is ready to jell. A clear amber colored jelly will result from use of this recipe.

Those who do not object to the flavor of the yellow portion of the rind may leave it on. The sediment from the settled juice will also make jelly but it will be cloudy.

Grape Fruit-Lemon Jelly.—By substituting grape fruit for oranges in the above recipes, a clear bitter jelly can be made.

Lemon Jelly.—Cut the lemons in half and press out the juice. Cut the pulp and rinds into small pieces. Return about one-third of the juice to the pulp and rinds. Cover with water and boil one hour, replacing the water that boils off. Press out the hot juice and proceed as in orange jelly recipe number one above. (The two-thirds of lemon juice rejected can be used for other purposes.)

Marmalades.—Most housewives make the mistake of leaving too much pulp and peel in their marmalade, giving it the appearance of jam rather than of marmalade. A marmalade should be a clear jelly with a few thin slices of peel suspended in it. The peel in the marmalade should be tender and should be well distributed and not all floating at the surface. This requires preliminary boiling of the thinly sliced skins to soften them and a second long boiling with the sugar and juice so that the syrup will penetrate and make peels and jelly of the same specific gravity or density. The following recipe conforms to these principles:

* Furnished by Miss Elliot of Domestic Science Department, Covina High School.

Orange-Lemon Marmalade.—Use six oranges and three lemons. Cut four of the oranges and the three lemons into slices about one-fourth of an inch thick. Cover with water. Boil about one hour, replacing occasionally during the boiling process the water that boils off. Drain and press out the hot juice through a coarse mesh-bag and place in jars or bottles to settle. Slice the remaining two oranges into very thin shavings or slices. Cover with a small amount of water and boil until tender. Mix the hot juice thus obtained in jars or bottles with the juice from the first oranges and lemons. Do not press the boiled slices, but wash most of adhering pulp from the skins under a good jet of water from a faucet. Drain off the water and set the peels aside until the next day. After twenty-four hours, pour or siphon off the clear juice set aside to settle in the bottles on the previous day. Add the boiled and washed thinly sliced peels from the two oranges to the clear juice. To each part of liquid and peels add one part of sugar. Heat with frequent skimming until the marmalade boils at 8° F. above the boiling point of water or until it sheets readily from a spoon. Pour into glasses and cover with paraffin.

Grape Fruit-Lemon Marmalade.—Proceed exactly as above except that pomelos are substituted for the oranges.

Grape Fruit-Orange-Lemon Marmalade.—Proceed as with orange marmalade using three pomelos, three oranges, and three lemons. The pomelos give a bitter taste and a marmalade resembling more or less the bitter English marmalade. The process is the same as for orange marmalade, including the use of two of the oranges to thicken.

QUANTITIES NEEDED FOR TEN GALLONS OF JELLY

	Weight of Fruit, in lbs.			Gallons of			Pounds	Yield of Jelly	
	Oranges	Lemons	Pomelos	Water added	Cloudy juice obtained	Clear juice obtained	Sugar added	Gallons	6-oz. glasses
1	68	17	....	15	11	9	90	10	270
2	....	12	58	15	11	9	90	10	270
3	....	75	....	17.5	11	9	95	10	270

The figures in the above table were obtained from small scale experiments but represent approximately the probable yield on a larger scale. Fruit of medium size was used and in the proportions given in the recipes i.e., for *orange-lemon jelly*, six oranges and three lemons; for *pomelo-lemon jelly*, six pomelos and three lemons; and for *lemon jelly*, twelve lemons less two-thirds of their juice.